Keywords: DACs, single supply DAC, variable negative control voltage, programmable negative voltage, positive to negative voltage translator, digital analog converter, digital to analog converters

APPLICATION NOTE 1074

DAC and Op Amp Generate Variable Negative Control Voltage

May 24, 2002

Abstract: This design idea describes a simple circuit to generate a programmable negative control voltage. It takes the output of a single supply digital-to-analog converter (DAC) and produces a variable negative voltage. The DAC output from 0V to +2.5V is converted to 0V to -5V at the output.

Early digital-to-analog converters (DACs) were designed with standard R-2R ladders, and produced a negative output voltage. These early DACs (such as the MX7837/MX7847 and MAX523) require both a positive and a negative supply rail to accommodate their negative output. With the transition to single-supply integrated circuits, however, many modern DACs now operate with a single supply rail and an inverted R-2R ladder. The inverted R-2R ladder produces a positive output voltage.

Despite the popularity of single-supply ICs, some applications still require a negative control voltage. One solution for this purpose is a modern, inverted R-2R ladder DAC and op amp (**Figure 1**). When compared with older DACs containing standard R-2R ladders, this approach offers lower supply voltages, higher speed, and smaller packages.

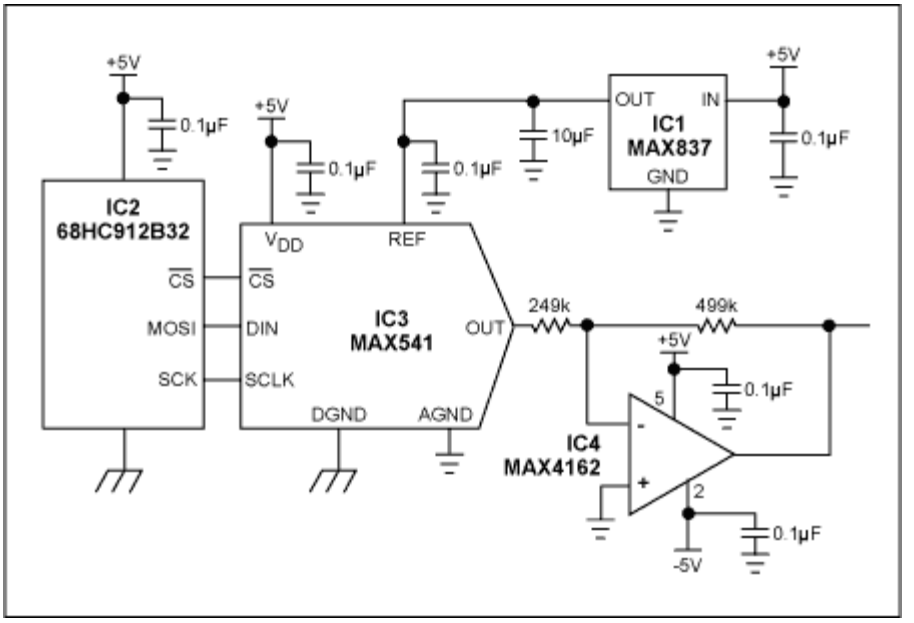

Figure 1. This compact circuit enables microcontroller IC2 to generate a variable negative voltage.

The DAC (IC3), operating with a 2.5V applied reference voltage from IC1 and driven by microcontroller IC2, produces an output swing from 0V to 2.5V. Op amp IC4 inverts and amplifies this output to produce a 0V to -5V output. For test purposes, a software routine enables the microcontroller to generate a 0V to -5V triangle-wave output.

Please note that the output impedance of the DAC (IC3) is 6.25kΩ ±20%. To eliminate system gain errors that are caused by the DAC's output impedance, buffer the DAC output before the IC4 inverting stage.

A similar version of this article appeared in the December 6, 2001 issue of *EDN* magazine.

Related Parts		
MAX4162	SOT23, Micropower, Single-Supply, Rail-to-Rail I/O Op Amps	Free Samples
MAX541	+5V, Serial-Input, Voltage-Output 16-Bit DACs	Free Samples
MAX542	+5V, Serial-Input, Voltage-Output 16-Bit DACs	Free Samples
MAX837	4-Pin Micropower Voltage Monitors	Free Samples

More Information
For Technical Support: http://www.maximintegrated.com/support
For Samples: http://www.maximintegrated.com/samples
Other Questions and Comments: http://www.maximintegrated.com/contact

Application Note 1074: http://www.maximintegrated.com/an1074
APPLICATION NOTE 1074, AN1074, AN 1074, APP1074, Appnote1074, Appnote 1074